PURPOSE AND BACKGROUND

Importance of Wetlands

In terms of human development and land use, wetlands have often been viewed as wastelands or areas with limited development potential. Historically wetlands have been drained or filled-in so that the land area could be "used for beneficial human purposes". This view of wetlands does not reflect the values and benefits associated with them. It is estimated that wetlands covered 220 million acres of the lower 48 states prior to European settlement (Brown & Lant, 1999). By the mid-1980s wetland areas had been reduced to 103 million acres, representing a loss of about 54% of the nations wetland areas. Prior to the 1980's wetlands were mainly converted to agricultural lands. Since the 1980's it is estimated that over 80% of wetland losses are due to non-agricultural activities (Brown & Lant, 1999). Wetlands serve a number of important functions and provide benefits to humans and wildlife. The following benefits of wetlands are often overlooked:

- ✓ **Wildlife habitat** – Many species are dependent upon wetlands for all or a portion of their life cycle. Wetlands provide habitat for fish, birds, mammals, reptiles, amphibians, and invertebrates.

- ✓ **Erosion control** –Wetlands support vegetation that acts as a flood buffer and reduces stream bank erosion during flooding events.

- ✓ **Floodwater storage** –Wetlands store water during flooding events and then slowly release the water as flooding subsides. This can significantly reduce peak flood flows and resulting flood damage downstream.

- ✓ **Ground water recharge** –Wetlands store surface water, which then infiltrates into the ground, providing recharge to aquifers. This ground water recharge in turn is slowly released back to adjacent surface water bodies, such as streams, providing water during low flow periods (base flow).

- ✓ **Water purification** –Wetlands improve water quality by filtering polluted runoff from cities and agricultural lands. They trap sediments, utilize excess nutrients present in runoff, and breakdown many waterborne contaminants. Constructed wetlands are being used to treat contaminated waters from mines, sewer systems, and urban stormwater runoff.

- ✓ **Recreation & Economic Benefits** –Wetlands are often visited for recreational purposes such as hiking, bird watching, wildlife photography, and hunting. These activities can translate into dollars spent at local businesses, adding to the economy.

- ✓ **Education –** Wetlands make excellent and inexpensive outdoor laboratories for students of all ages. For example, the Cherry River recreation site located on the north side of Bozeman, Montana is visited by hundreds of school children each year. The students get to see numerous plants and animals, and the cost to local schools is minor, other than the transportation.

Research has been conducted to try and determine what the economic benefits of wetlands are. The monetary value of the ecological functions that various ecosystems provide, relative to what it would cost for humans to engineer facilities to perform the functions was evaluated by Mitsch and Gosselink (2000). Table 1 shows the results of their analysis. Estuaries and wetlands had much higher values than other ecosystems.

Table 1
Functional Ecological Value of Wetlands and other Ecosystems

Ecosystem Type	Unit Value ($/ha/year)
Estuaries	$22,832
Wetlands	$14,785
Lakes and Rivers	$8,498
Forests	$969
Grasslands	$232

From Mitsch & Gosselink (2000)

Importance of Riparian Areas
For purposes of this report, riparian areas are defined as the areas in and adjacent to rivers and streams where woody vegetation (trees and shrubs) is present. Like wetlands, riparian areas serve a number of important functions and provide benefits to humans and wildlife. However, rather than being viewed as wastelands, riparian areas are often targeted for residential and commercial development for aesthetic reasons. While low levels of development within riparian areas may not cause significant problems, widespread development in and adjacent to riparian corridors can degrade the ecological function of the area and present public health and safety problems. These safety problems are mainly due to the natural flooding processes that occur in riparian habitat. As an example, Figure 1 shows a house that fell into the West Gallatin River during a flooding event in June of 1986. Note the proximity of the house to the river and the riparian vegetation around the home site.

Figure 1. House destroyed by flooding of the West Gallatin River in June 1986 (Photo courtesy of Scott Gillilan).

The following benefits of riparian areas often overlooked:

- ✓ **Erosion Control –**Roots of trees, shrubs, and grasses hold soil in place along the banks of rivers and streams, reducing the potential for bank erosion, and deposition of sediment in streams and rivers.

- ✓ **Flood Control –**Vegetation along the banks of rivers and streams and within floodplains slows the movement of floodwaters. The vegetation also aids in dispersing the floodwaters and allowing some of the water to soak into the floodplain adjacent to the river or stream.

- ✓ **Wildlife Habitat** –Riparian areas provide important wildlife habitat. Trees and other vegetation provide cover and shelter for wildlife. The riparian areas also serve as migration corridors for wildlife. Roots from trees and shrubs along the banks of rivers and streams often form "holes" that provide shelter for fish.

- ✓ **Temperature Control –**Trees and shrubs adjacent to rivers and streams provide shade, which reduced water temperatures. High water temperatures harm fish and other aquatic life.

- ✓ **Recreation & Economic benefits** –Like wetlands, riparian areas are often visited for recreational purposes such as hiking, bird watching, wildlife photography, fishing, and hunting. These activities can translate into dollars spent at local businesses, adding to the local economy.

- ✓ **Filtering of Runoff** –Riparian vegetation in floodplains and along rivers and streams act as natural filters to remove sediment and other contaminants from stormwater runoff from adjacent land surfaces.

Funding

This project was partially funded by the Montana Department of Environmental Quality (DEQ) Wetland Protection Program through DEQ contract # 202014. The DEQ grant funding of $53,989 originated through the U. S. Environmental Protection Agency (EPA) Region VIII Ecosystems Protection Program. In addition, cash and in-kind services totaling more than $40,122 were contributed as match. The Gallatin Local Water Quality District administered the project and provided matching funds. The agencies and organizations listed in Table 2 also provided matching funds.

Table 2
Matching Funds Provided by Agencies and Organizations

Agency or Organization	In-Kind Match	Cash Match
Bozeman Watershed Council	$2,300	
City of Bozeman Planning Department		$5,000
Gallatin County Disaster and Emergency Services		$5,000
Gallatin County GIS Department		$7,583
Gallatin County Planning Board		$2,000
Gallatin Local Water Quality District	$16,018	$1,552
Volunteers (calc. At $8/hour * 83.5 hours)	$668	
Totals	$18,986	$21,135

Project Area Description
The project area is located within Gallatin County, in southwestern Montana. With the exception of the western margin, the project area is located within the boundary of the Gallatin Local Water Quality District (GLWQD). Figure 2 shows the location of Gallatin County and the GLWQD within Montana.

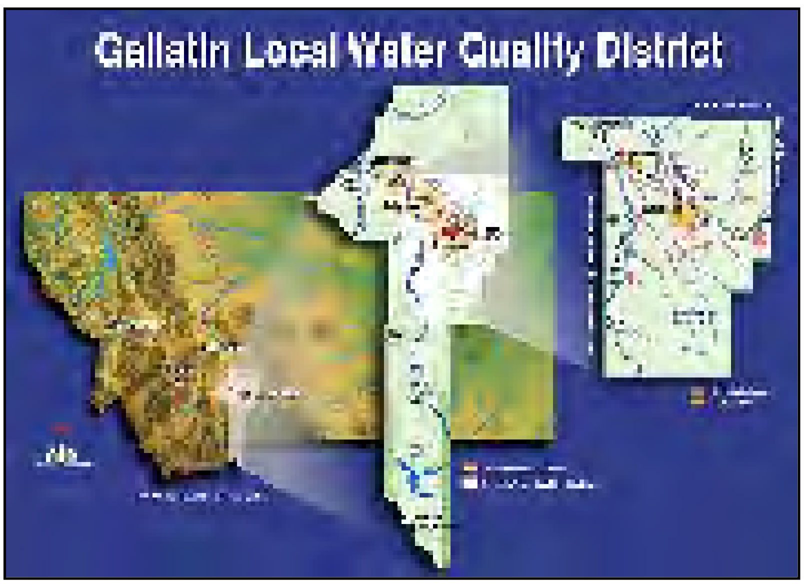

Figure 2. Location of Gallatin County and Gallatin Local Water Quality District in Montana.

The project area and project area boundary are shown in Figure 3. The area covers approximately 520 square miles, centered over the Gallatin Valley. The project area boundary generally follows the margins of the floor of the Gallatin Valley, with the exception of including the upper Bozeman Creek watershed. This area was included as a cooperative effort to assist the Bozeman Watershed Council with a resource assessment of the Bozeman Creek watershed, which included an inventory of wetlands.

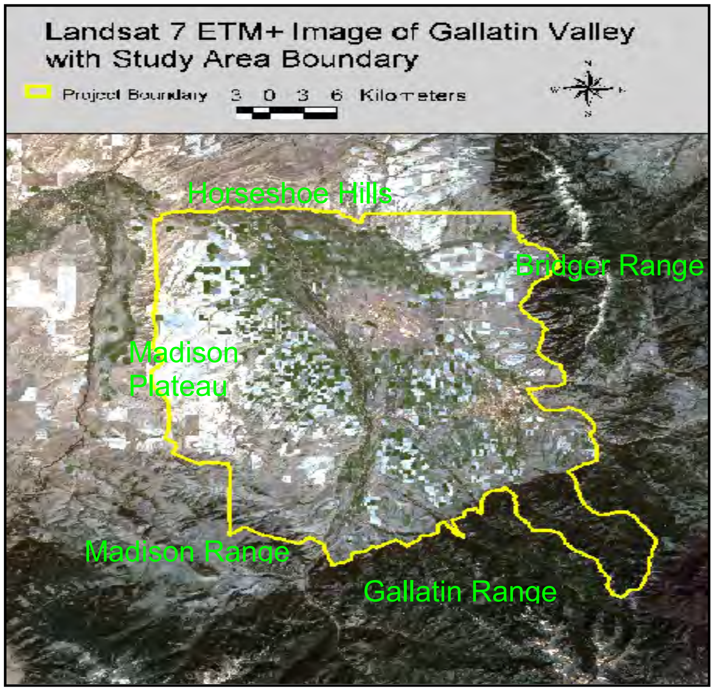

Figure 3. Oblique Landsat satellite view of the Gallatin Valley showing the project area and the major landforms surrounding the project area.

Hydrogeologic Setting

The Gallatin Valley is bounded by the Gallatin Range to the south, the Bridger Range to the east, the Horseshoe Hills to the north, the Madison Plateau to the west, and the Madison Range to the southwest (Figure 3). Elevations in the valley range from about 4,800 to 4,100 feet above mean sea level. The climate in the valley is semi-arid with annual precipitation ranging from about 12 to 18 inches. The surrounding mountains receive significantly more precipitation, primarily as snow. The Gallatin, Madison, and Bridger ranges provide most of the runoff that supports streams and rivers in the valley. These mountains are also the main source of ground water recharge for the valley aquifer system (Hackett 1960, Slagle 1995).

The Gallatin Valley is a large intermontane valley, which occupies the eastern half of a much larger structural basin known as the Three Forks structural basin (Hackett, 1960). The spatial distribution of wetland and riparian features in the valley appears to be heavily influenced by the tectonic setting and resulting bedrock structure of the area. As a result of the bedrock structure, the floor of the valley slopes downward from the southeast towards the northwest. Figure 4 shows an oblique high-altitude aerial view of the valley created by overlaying a mosaic of color infrared imagery over digital elevation model (DEM) data. The general tilt of the valley floor from southeast (Bozeman Area) towards the northwest (Logan area) can be visualized in the view. Note also the striking linear boundary between the valley floor near Manhattan and the bedrock structure of the Horseshoe Hills to the north, seen in the lower foreground of Figure 4. This feature suggests the presence of a fault with the valley floor dropped down on the south side of the fault.

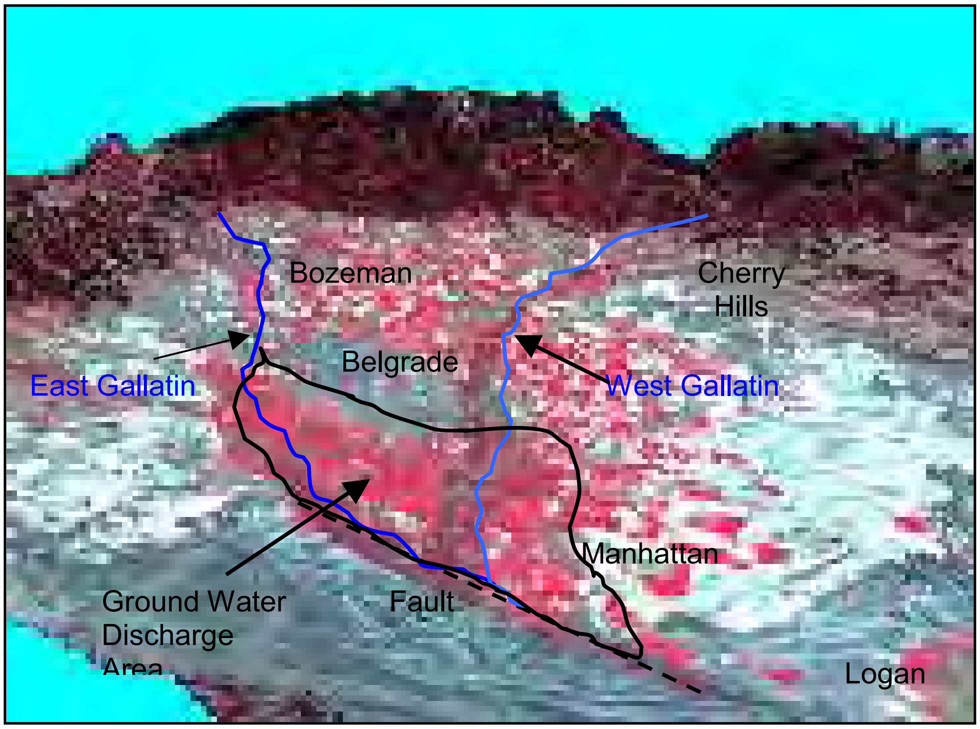

Figure 4. Oblique high altitude view of the Gallatin Valley looking towards the Southeast, from over the Horseshoe Hills. The color infrared imagery created for the project is draped over a digital elevation model to produce the view.

The view in Figure 4 shows that the West Gallatin and East Gallatin rivers, and all of their tributary streams, flow from their headwaters out into the valley towards the northwest corner, merging near the town of Logan. The West Gallatin River initially flows due north, blocked from flowing towards the northwest by the bedrock foothills of the Madison Range (Cherry Hills). North of Belgrade and Manhattan the East Gallatin River flows up against the northern edge of the valley, following the fault boundary exposing the bedrock of the Horseshoe Hills. The behavior of the river and the linear nature of the bedrock outcrops in this area suggest that the valley may still be tectonically active.

Ground-water flow patterns, as mapped by Slagle (1995), mimic the surface water flow patterns, with ground water flowing from the east, southeast, and south towards the northwest. Where ground water merges in the northern portion of the valley a large ground water discharge area is present. This discharge area is inferred from the presence of shallow ground water, the appearance of numerous spring fed creeks, and a concentration of darker shades of red on the CIR imagery as shown in the center foreground in Figure 4.